

**Roanoke River Implementation Plan – Part I**  
**BMP Cost Effectiveness and Implementation Staging**  
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Prepared for:



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## **BMP Cost-Effectiveness Tables**

Louis Berger (LB) and the Virginia Department of Environmental Quality (VADEQ) have calculated the cost-effectiveness of each proposed BMP which has quantifiable bacteria and sediment reductions in the Roanoke River Implementation Plan. The cost-effectiveness is based on the amount of bacteria (in cfu/day, Table 1) and sediment (in pounds, Table 2) reduced per \$1,000 spent. Table 2 also presents the sediment cost-effectiveness in dollars spent to reduce 1,000 pounds of sediment. For bacteria, the effectiveness values are based on the bacteria loading from the Tinker Creek subwatershed. Since bacteria loads differ in each subwatershed, there would be slight differences in bacteria loads reduced per \$1,000 spent if one used another watershed as the basis for Table 1. Tables 1 and 2 provide a general comparison of the cost-effectiveness of the various BMPs, ranked by level of cost-effectiveness.

<b>Table 1. BMP Cost-Effectiveness for Bacteria Reduction in the Roanoke River Watershed</b>	
<b>BMP</b>	<b>Bacteria Reduction per \$1,000 (in cfu/day)</b>
<b>Stormwater BMPs</b>	
Riparian Buffer: Grass/Shrub	2.27E+11
Constructed Wetland	4.52E+10
Riparian Buffer: Forest	2.67E+10
Infiltration Trench	2.46E+10
Urban Land Use Conversion	2.33E+10
Rain Gardens	2.29E+10
Bioretention	1.47E+10
Detention Pond	1.29E+10
Manufactured BMPs	6.55E+09
Street Sweeping	1.06E+09
<b>Residential BMPs</b>	
Repaired Septic System (RB-3)	2.18E+10
Septic System Pump-Out (RB-1)	1.31E+10
Septic System Installation/Replacement (RB-4)	1.31E+10
Sewer Connection (RB-2)	8.27E+09
Pet Waste Management Education Program	8.19E+09
Alternative Waste Treatment System Installation (RB-5)	4.91E+09
<b>Cropland BMPs</b>	
Continuous No-Till (SL-15)	1.25E+14
Small Grain Cover Crop (SL-8)	1.19E+14
Permanent vegetative cover on cropland (SL-1)	7.66E+13
Cropland Buffer/Field Borders (CP-33 and WQ-1)	1.49E+13
Sod Waterway (WP-3)	5.58E+12
<b>Pasture BMPs</b>	
Pasture Management (EQIP 528, SL-10T, SL-9)	1.21E+12
Wet Detention Pond	8.46E+11
Reforestation of Erodible Pasture (FR-1)	2.82E+11
Vegetative Cover on Critical Areas (SL-11)	1.13E+11
<b>Livestock Exclusion BMPs</b>	
Small Acreage Grazing System (SL-6AT)	4.15E+11
Livestock Exclusion with Reduced Setback (LE-2T)	2.19E+11
Livestock Exclusion (SL-6T/LE-1T)	1.78E+11
Stream Protection Fencing (WP-2T)	1.49E+11
Livestock Exclusion (CRSL-6)	1.38E+11

<b>Table 2. BMP Cost Efficiency for Sediment Reduction in the Roanoke River Watershed</b>		
<b>BMP</b>	<b>Sediment Reduction (in lbs) per \$1,000 spent</b>	<b>Cost (in \$) per 1,000 lbs of Sediment Removed</b>
<b>Stormwater BMPs</b>		
Street Sweeping*	2,133.2	\$469
Riparian Buffer: Grass/Shrub	332.1	\$3,011
Rain Barrel	159.4	\$6,274
Urban Land Use Conversion	65.5	\$15,257
Riparian Buffer: Forest	47.8	\$20,913
Constructed Wetland	41.2	\$24,259
Rain Gardens	33.5	\$29,875
Detention Pond	31.5	\$31,788
Infiltration Trench	29.9	\$33,461
Bioretention	16.7	\$59,751
Manufactured BMPs	9.6	\$104,564
Vegetated Swale	8.6	\$116,790
Permeable Paver	0.8	\$1,254,770
<b>Cropland BMPs</b>		
Continuous No-Till (SL-15)	8,690.4	\$115
Small Grain Cover Crop (SL-8)	8,276.5	\$121
Permanent vegetative cover on cropland (SL-1)	5,320.6	\$188
Cropland Buffer/Field Borders (CP-33 and WQ-1)	1,034.6	\$967
Sod Waterway (WP-3)	388.0	\$2,578
<b>Pasture BMPs</b>		
Pasture Management (EQIP 528, SL-10T)	301.0	\$3,323
Wet Detention Pond	250.8	\$3,987
Reforestation of Erodible Pasture (FR-1)	117.1	\$8,541
Vegetative Cover on Critical Areas (SL-11)	47.0	\$21,265
<b>Livestock Exclusion BMPs</b>		
Small Acreage Grazing System (SL-6AT)	4.7	\$213,598
Livestock Exclusion with Reduced Setback (LE-2T)	2.5	\$403,463
Livestock Exclusion (SL-6T/LE1-T)	2.0	\$498,396
Stream Protection/Fencing (WP-2T)	1.7	\$593,328
Livestock Exclusion (CRSL-6)	1.6	\$640,794
<b>Stream Restoration</b>		
Stream Restoration**	1,033.3	\$968

\*Per curb mile per year (rate of one cycle per month)

\*\*Per foot per year

## **Draft Staging of BMPs**

At this point in the development of the Roanoke River Implementation Plan, the BMPs needed to attain the bacteria and sediment reductions called for in the TMDLs have been quantified and reviewed by stakeholders. The next step is to develop timelines for implementing the BMPs proposed in each subwatershed. The implementation actions will occur in stages across an agreed-upon time period. LB and VADEQ have developed a draft three-stage plan for each subwatershed in the first phase of the Roanoke River Implementation Plan. The first stage focuses on implementing the more cost-effective and commonly implemented actions. The second stage focuses on implementing the majority of the remaining BMPs in order to reach the goal of delisting the bacteria impaired segments. The third stage goal is to attain the bacteria and bacteria/sediment reductions required by the TMDLs, while implementing the remainder of the more expensive BMPs. The period of implementation will vary by the size of the subwatershed:

- For smaller and/or more rural subwatersheds, LB and VADEQ are proposing a 15-year implementation plan. The first two stages will be implemented over 6 years each; the final stage will be implemented over 3 years. We are proposing this plan for the following subwatersheds: *Carvin Creek, Peters Creek, Mason Creek, and Back Creek.*
- For larger and/or more urbanized subwatersheds, LB and VADEQ are proposing a 20-year implementation plan. The first two stages will be implemented over 8 years each; the final stage will be implemented over 4 years. We are proposing this plan for the following subwatersheds: *Glade Creek, Tinker Creek, Lick Run, Mud Lick/Murray/Ore Branch, Roanoke River 1 and Roanoke River 2.*

For each subwatershed, Tables 3 to 22 present BMPs by percentage of implementation per stage and by quantified number of BMPs per stage. The percentages and numbers shown reflect the cumulative percentage of BMPs implemented for all stages. These tables correspond to the following subwatersheds:

- Tables 3 and 4           Back Creek
- Tables 5 and 6           Carvin Creek
- Tables 7 and 8           Glade Creek
- Tables 9 and 10          Lick Run
- Tables 11 and 12        Mason Creek
- Tables 13 and 14        Mud Lick Creek, Murray Run, and Ore Branch Carvin Creek
- Tables 15 and 16        Peters Creek
- Tables 17 and 18        Roanoke River 1
- Tables 19 and 20        Roanoke River 2
- Tables 21 and 22        Tinker Creek

<b>Table 3. Back Creek Implementation Staging</b>			
Best Management Practice	Stage I (Y1-Y6)	Stage II (Y7-Y12) Delisting Stage	Stage III (Y13-Y15) TMDL Attainment Stage
<b>Residential BMPs</b>			
Septic System Pump-Out (RB-1)	50%	100%	-
Sewer Connection (RB-2)	50%	100%	-
Repaired Septic System (RB-3)	50%	100%	-
Septic System Installation/Replacement (RB-4)	50%	100%	-
Alternative Waste Treatment System Installation (RB-5)	50%	100%	-
Pet Waste Management Education Program	Program	Program	Program
Pet Waste Station	75%	100%	-
<b>Existing BMPs and Detention Pond Retrofits</b>			
Infiltration Trench	75%	100%	-
Constructed Wetlands	75%	100%	-
Street Sweeping	Program	Program	Program
<b>Stormwater BMPs</b>			
Bioretention	25%	90%	100%
Rain Gardens	50%	90%	100%
Infiltration Trench	25%	90%	100%
Manufactured BMPs	50%	90%	100%
Constructed Wetland	25%	90%	100%
Detention Pond	25%	90%	100%
Riparian Buffer: Forest	50%	100%	-
Riparian Buffer: Grass/Shrub	50%	100%	-
Urban Tree Canopy/Land Use Conversion	25%	90%	100%
<b>Cropland BMPs</b>			
Continuous No-Till (SL-15)	100%	-	-
Small Grain Cover Crop (SL-8)	100%	-	-
<b>Livestock Exclusion Systems</b>			
Livestock Exclusion (SL-6T/LE-1T)	75%	100%	-
Livestock Exclusion with Reduced Setback (LE-2T)	100%	-	-
Small Acreage Grazing System (SL-6AT)	100%	-	-
Stream Protection Fencing (WP-2T)	100%	-	-
<b>Pasture BMPs</b>			
Reforestation of Erodible Pasture (FR-1)	75%	100%	-
Pasture Management (EQIP 528, SL-10T, SL-9)	50%	100%	-
Vegetative Cover on Critical Areas (SL-11)	50%	100%	-
Wet Detention Pond	0%	0%	100%

**Table 4. Back Creek Implementation Staging**

Best Management Practice	Unit	Stage I (Y1-Y6)*	Stage II (Y7-Y12)* Delisting Stage	Stage III (Y13-Y15)* TMDL Attainment Stage
<b>Residential BMPs</b>				
Septic System Pump-Out (RB-1)	Pump Out	216	432	-
Sewer Connection (RB-2)	System	47	94	-
Repaired Septic System (RB-3)	System	164	328	-
Septic System Installation/Replacement (RB-4)	System	176	352	-
Alternative Waste Treatment System Installation (RB-5)	System	17	34	-
Pet Waste Management Education Program	Program	Program	Program	Program
Pet Waste Station	Unit	4	5	-
<b>Existing BMPs and Detention Pond Retrofits</b>				
Infiltration Trench	System	28	37	-
Constructed Wetlands	System	13	17	-
Street Sweeping(additional miles to be swept annually)**	Program	8,604	8,604	4,302
<b>Stormwater BMPs</b>				
Bioretention	Acre Treated	380.0	1,368.0	1520.0
Rain Gardens	Acre Treated	152.0	273.6	304.0
Infiltration Trench	Acre Treated	75.8	272.7	303.0
Manufactured BMPs	Acre Treated	183.5	330.3	367.0
Constructed Wetland	Acre Treated	645.0	2322.0	2580.0
Detention Pond	Acre Treated	49.0	176.4	196.0
Riparian Buffer: Forest	Acre Installed	19.0	38.0	-
Riparian Buffer: Grass/Shrub	Acre Installed	19.0	38.0	-
Urban Tree Canopy/Land Use Conversion	Acre Converted	20.3	72.9	81.0
<b>Cropland BMPs</b>				
Continuous No-Till (SL-15)	Acre Installed	63.0	-	-
Small Grain Cover Crop (SL-8)	Acre Installed	63.0	-	-
<b>Livestock Exclusion Systems</b>				
Livestock Exclusion (SL-6T/LE-1T)	System	26	35	-
Livestock Exclusion with Reduced Setback (LE-2T)	System	4	-	-
Small Acreage Grazing System (SL-6AT)	System	2	-	-
Stream Protection Fencing (WP-2T)	System	1	-	-
<b>Pasture BMPs</b>				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	106.5	142.0	-
Pasture Management (EQIP 528, SL-10T, SL-9)	Acre Installed	1,347.0	2,694.0	-
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	134.5	269.0	-
Wet Detention Pond	Acre Treated	0.0	0.0	1,450.0

\*Numbers represent cumulative total of BMPs implemented

\*\*Mileage shown corresponds to the total additional miles to be swept within the implementation plan stage (Annual Miles x Number of Years). This implementation plan is proposing to sweep 1,434 additional miles per year in Back Creek.



<b>Table 5. Carvin Creek Implementation Staging</b>			
Best Management Practice	Stage I (Y1-Y6)	Stage II (Y7-Y12) Delisting Stage	Stage III (Y13-Y15) TMDL Attainment Stage
<b>Residential BMPs</b>			
Septic System Pump-Out (RB-1)	100%	-	-
Sewer Connection (RB-2)	100%	-	-
Repaired Septic System (RB-3)	100%	-	-
Septic System Installation/Replacement (RB-4)	100%	-	-
Alternative Waste Treatment System Installation (RB-5)	100%	-	-
Pet Waste Management and Education Program	Program	Program	Program
Pet Waste Station	75%	100%	-
<b>Existing BMPs and Detention Pond Retrofits</b>			
Infiltration Trench	75%	100%	-
Constructed Wetlands	75%	100%	-
Street Sweeping	Program	Program	Program
<b>Stormwater BMPs</b>			
Bioretention	25%	90%	100%
Rain Gardens	50%	90%	100%
Infiltration Trench	25%	90%	100%
Manufactured BMPs	50%	90%	100%
Constructed Wetland	25%	90%	100%
Detention Pond	25%	90%	100%
Permeable Paver	25%	75%	100%
Vegetated Swale	25%	90%	100%
Rain Barrel	50%	100%	-
Riparian Buffer: Forest	75%	100%	-
Riparian Buffer: Grass/Shrub	75%	100%	-
Urban Tree Canopy/Land Use Conversion	25%	90%	100%
<b>Livestock Exclusion Systems and Manure Management</b>			
Livestock Exclusion (CRSL-6)	100%	-	-
Livestock Exclusion (SL-6T/LE-1T)	100%	-	-
Livestock Exclusion with Reduced Setback (LE-2T)	100%	-	-
Manure Storage (WP-4)	100%	-	-
<b>Pasture BMPs</b>			
Reforestation of Erodible Pasture (FR-1)	50%	100%	-
Pasture Management (EQIP 528, SL-10T, SL-9)	100%	-	-
Vegetative Cover on Critical Areas (SL-11)	50%	100%	-
<b>Stream Restoration</b>			
Stream Restoration	50%	100%	-

**Table 6. Carvin Creek Implementation Staging**

Best Management Practice	Unit	Stage I (Y1-Y6)*	Stage II (Y7-Y12)* Delisting Stage	Stage III (Y13-Y15)* TMDL Attainment Stage
<b>Residential BMPs</b>				
Septic System Pump-Out (RB-1)	Pump Out	22	-	-
Sewer Connection (RB-2)	System	181	-	-
Repaired Septic System (RB-3)	System	16	-	-
Septic System Installation/Replacement (RB-4)	System	18	-	-
Alternative Waste Treatment System Installation (RB-5)	System	2	-	-
Pet Waste Management Education Program	Program	Program	Program	Program
Pet Waste Station	Unit	5	-	-
<b>Existing BMPs and Detention Pond Retrofits</b>				
Infiltration Trench	System	26	35	-
Constructed Wetlands	System	26	34	-
Street Sweeping (additional miles to be swept annually)**	Miles Swept	3,384	3,384	1,692
<b>Stormwater BMPs</b>				
Bioretention	Acre Treated	147.5	531.0	590.0
Rain Gardens	Acre Treated	59.0	106.2	118.0
Infiltration Trench	Acre Treated	29.3	105.3	117.0
Manufactured BMPs	Acre Treated	71.0	127.8	142.0
Constructed Wetland	Acre Treated	394.3	1,419.3	1,577.0
Detention Pond	Acre Treated	49.0	176.4	196.0
Permeable Paver	Acre Treated	1.3	3.8	5.0
Vegetated Swale	Acre Treated	37.5	135.0	150.0
Rain Barrel	System	74	147	-
Riparian Buffer: Forest	Acre Installed	12	16	-
Riparian Buffer: Grass/Shrub	Acre Installed	12	16	-
Urban Tree Canopy/Land Use Conversion	Acre Converted	7	25	28
<b>Livestock Exclusion Systems and Manure Management</b>				
Livestock Exclusion (CRSL-6)	System	1	-	-
Livestock Exclusion (SL-6T/LE-1T)	System	7	-	-
Livestock Exclusion with Reduced Setback (LE-2T)	System	1	-	-
Manure Storage (WP-4)	System	2	-	-
<b>Pasture BMPs</b>				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	27.0	54.0	-
Pasture Management (EQIP 528, SL-10T)	Acre Installed	487.0	-	-
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	48.5	97.0	-
<b>Stream Restoration</b>				
Stream Restoration	Feet	6,217	12,433	-

\*Numbers represent cumulative total of BMPs implemented

\*\*Mileage shown corresponds to the total additional miles to be swept within the implementation plan stage (Annual Miles x Number of Years). This implementation plan is proposing to sweep 564 additional miles per year in Carvin Creek.

<b>Table 7. Glade Creek Implementation Staging</b>			
Best Management Practice	Stage I (Y1-Y8)	Stage II (Y9-Y16) Delisting Stage	Stage III (Y17-Y20) TMDL Attainment Stage
<b>Residential BMPs</b>			
Septic System Pump-Out (RB-1)	75%	100%	-
Sewer Connection (RB-2)	50%	100%	-
Repaired Septic System (RB-3)	75%	100%	-
Septic System Installation/Replacement (RB-4)	75%	100%	-
Alternative Waste Treatment System Installation (RB-5)	75%	100%	-
Pet Waste Management Education Program	Program	Program	Program
Pet Waste Station	75%	100%	-
<b>Existing BMPs and Detention Pond Retrofits</b>			
Infiltration Trench	75%	100%	-
Constructed Wetlands	75%	100%	-
Street Sweeping	Program	Program	Program
<b>Stormwater BMPs</b>			
Bioretention	25%	90%	100%
Rain Gardens	50%	90%	100%
Infiltration Trench	25%	90%	100%
Manufactured BMPs	50%	90%	100%
Constructed Wetland	25%	90%	100%
Detention Pond	25%	90%	100%
Permeable Paver	25%	75%	100%
Vegetated Swale	25%	90%	100%
Rain Barrel	50%	100%	-
Riparian Buffer: Forest	75%	100%	-
Riparian Buffer: Grass/Shrub	75%	100%	-
Urban Tree Canopy/Land Use Conversion	25%	90%	100%
<b>Cropland BMPs</b>			
Continuous No-Till (SL-15)	100%	-	-
Small Grain Cover Crop (SL-8)	100%	-	-
Permanent vegetative cover on cropland (SL-1)	100%	-	-
Sod Waterway (WP-3)	100%	-	-
Cropland Buffer/Field Borders (CP-33 and WQ-1)	100%	-	-
<b>Livestock Exclusion Systems and Manure Management</b>			
Livestock Exclusion (CRSL-6)	75%	100%	-
Livestock Exclusion (SL-6T/LE-1T)	75%	100%	-
Livestock Exclusion with Reduced Setback (LE-2T)	50%	100%	-
Small Acreage Grazing System (SL-6AT)	100%	-	-
Stream Protection Fencing (WP-2T)	100%	-	-
Manure Storage (WP-4)	75%	100%	-
<b>Pasture BMPs</b>			
Reforestation of Erodible Pasture (FR-1)	50%	100%	-
Pasture Management (EQIP 528, SL-10T, SL-9)	50%	100%	-
Vegetative Cover on Critical Areas (SL-11)	50%	100%	-
<b>Stream Restoration</b>			
Stream Restoration	100%	-	-

**Table 8. Glade Creek Implementation Staging**

Best Management Practice	Unit	Stage I (Y1-Y8)*	Stage II (Y9-Y16)* Delisting Stage	Stage III (Y17-Y20)* TMDL Attainment Stage
<b>Residential BMPs</b>				
Septic System Pump-Out (RB-1)	Pump Out	448	597	-
Sewer Connection (RB-2)	System	133	265	-
Repaired Septic System (RB-3)	System	383	511	-
Septic System Installation/Replacement (RB-4)	System	322	429	-
Alternative Waste Treatment System Installation (RB-5)	System	34	45	-
Pet Waste Management Education Program	Program	Program	Program	Program
Pet Waste Station	Unit	5	6	-
<b>Existing BMPs and Detention Pond Retrofits</b>				
Infiltration Trench	System	17	22	-
Constructed Wetlands	System	23	31	-
Street Sweeping(additional miles to be swept annually)**	Miles Swept	2,600	2,600	1,300
<b>Stormwater BMPs</b>				
Bioretention	Acre Treated	221.3	796.5	885.0
Rain Gardens	Acre Treated	88.5	159.3	177.0
Infiltration Trench	Acre Treated	44.0	158.4	176.0
Manufactured BMPs	Acre Treated	107.0	192.6	214.0
Constructed Wetland	Acre Treated	1,003.3	3,611.7	4,013.0
Detention Pond	Acre Treated	49.0	176.4	196.0
Permeable Paver	Acre Treated	1.3	3.8	5.0
Vegetated Swale	Acre Treated	37.5	135.0	150.0
Rain Barrel	System	123	245	-
Riparian Buffer: Forest	Acre Installed	12.0	16.0	-
Riparian Buffer: Grass/Shrub	Acre Installed	12.0	16.0	-
Urban Tree Canopy/Land Use Conversion	Acre Converted	7.5	27.0	30.0
<b>Cropland BMPs</b>				
Continuous No-Till (SL-15)	Acre Installed	50.0	-	-
Small Grain Cover Crop (SL-8)	Acre Installed	45.0	-	-
Permanent vegetative cover on cropland (SL-1)	Acre Installed	3.0	-	-
Sod Waterway (WP-3)	Acre Installed	7.0	-	-
Cropland Buffer/Field Borders (CP-33 and WQ-1)	Acre Installed	3.0	-	-
<b>Livestock Exclusion Systems and Manure Management</b>				
Livestock Exclusion (CRSL-6)	System	3	4	-
Livestock Exclusion (SL-6T/LE-1T)	System	41	55	-
Livestock Exclusion with Reduced Setback (LE-2T)	System	3	6	-
Small Acreage Grazing System (SL-6AT)	System	3	-	-
Stream Protection Fencing (WP-2T)	System	2	-	-
Manure Storage (WP-4)	System	12	16	-
<b>Pasture BMPs</b>				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	201.0	402.0	-
Pasture Management (EQIP 528, SL-10T, SL-9)	Acre Installed	1,809.0	3,618.0	-
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	362.0	724.0	-
<b>Stream Restoration</b>				
Stream Restoration	Feet	11,818	-	-

\*Numbers represent cumulative total of BMPs implemented

\*\*Mileage shown corresponds to the total additional miles to be swept within the implementation plan stage (Annual Miles x Number of Years). This implementation plan is proposing to sweep 325 additional miles per year in Glade Creek.

<b>Table 9. Lick Run Implementation Staging</b>			
Best Management Practice	Stage I (Y1-Y8)	Stage II (Y9-Y16) Delisting Stage	Stage III (Y17-Y20) TMDL Attainment Stage
<b>Residential BMPs</b>			
Septic System Pump-Out (RB-1)	100%	-	-
Sewer Connection (RB-2)	75%	100%	-
Repaired Septic System (RB-3)	100%	-	-
Septic System Installation/Replacement (RB-4)	100%	-	-
Alternative Waste Treatment System Installation (RB-5)	100%	-	-
Pet Waste Management Education Program	Program	Program	Program
Pet Waste Station	75%	100%	-
<b>Existing BMPs and Detention Pond Retrofits</b>			
Infiltration Trench	75%	100%	-
Constructed Wetlands	75%	100%	-
Street Sweeping	Program	Program	Program
<b>Stormwater BMPs</b>			
Bioretention	25%	90%	100%
Rain Gardens	50%	90%	100%
Infiltration Trench	25%	90%	100%
Manufactured BMPs	50%	90%	100%
Constructed Wetland	25%	90%	100%
Detention Pond	25%	90%	100%
Permeable Paver	25%	75%	100%
Vegetated Swale	25%	90%	100%
Rain Barrel	50%	100%	-
Riparian Buffer: Forest	75%	100%	-
Riparian Buffer: Grass/Shrub	75%	100%	-
Urban Tree Canopy/Land Use Conversion	25%	90%	100%
<b>Pasture BMPs</b>			
Reforestation of Erodible Pasture (FR-1)	100%	-	-
Pasture Management (EQIP 528, SL-10T, SL-9)	100%	-	-
Vegetative Cover on Critical Areas (SL-11)	100%	-	-
Wet Detention Pond	0%	0%	100%
<b>Stream Restoration</b>			
Stream Restoration	100%	-	-

**Table 10. Lick Run Implementation Staging**

Best Management Practice	Unit	Stage I (Y1-Y8)*	Stage II (Y9-Y16)* Delisting Stage	Stage III (Y17-Y20)* TMDL Attainment Stage
<b>Residential BMPs</b>				
Septic System Pump-Out (RB-1)	Pump Out	2	-	-
Sewer Connection (RB-2)	System	84	112	-
Repaired Septic System (RB-3)	System	1	-	-
Septic System Installation/Replacement (RB-4)	System	5	-	-
Alternative Waste Treatment System Installation (RB-5)	System	-	-	-
Pet Waste Management Education Program	Program	Program	Program	Program
Pet Waste Station	Unit	14	19	-
<b>Existing BMPs and Detention Pond Retrofits</b>				
Infiltration Trench	System	8	10	-
Constructed Wetlands	System	25	33	-
Street Sweeping(additional miles to be swept annually)**	Miles Swept	6,304	6,304	3,152
<b>Stormwater BMPs</b>				
Bioretention	Acre Treated	487.5	1,755.0	1,950.0
Rain Gardens	Acre Treated	195.0	351.0	390.0
Infiltration Trench	Acre Treated	97.0	349.2	388.0
Manufactured BMPs	Acre Treated	235.5	423.9	471.0
Constructed Wetland	Acre Treated	537.5	1,935.0	2,150.0
Detention Pond	Acre Treated	49.0	176.4	196.0
Permeable Paver	Acre Treated	1.3	3.8	5.0
Vegetated Swale	Acre Treated	37.5	135.0	150.0
Rain Barrel	System	123	246	-
Riparian Buffer: Forest	Acre Installed	17.3	23.0	-
Riparian Buffer: Grass/Shrub	Acre Installed	17.3	23.0	-
Urban Tree Canopy/Land Use Conversion	Acre Converted	7.8	27.9	31.0
<b>Pasture BMPs</b>				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	6.0	-	-
Pasture Management (EQIP 528, SL-10T, SL-9)	Acre Installed	53.0	-	-
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	11.0	-	-
Wet Detention Pond	Acre Treated	0.0	0.0	15.0
<b>Stream Restoration</b>				
Stream Restoration	Feet	1,203	-	-

\*Numbers represent cumulative total of BMPs implemented

\*\*Mileage shown corresponds to the total additional miles to be swept within the implementation plan stage (Annual Miles x Number of Years). This implementation plan is proposing to sweep 788 additional miles per year in Lick Run.

<b>Table 11. Mason Creek Implementation Staging</b>			
Best Management Practice	Stage I (Y1-Y6)	Stage II (Y7-Y12) Delisting Stage	Stage III (Y13-Y15) TMDL Attainment Stage
<b>Residential BMPs</b>			
Septic System Pump-Out (RB-1)	100%	-	-
Sewer Connection (RB-2)	25%	75%	100%
Repaired Septic System (RB-3)	100%	-	-
Septic System Installation/Replacement (RB-4)	100%	-	-
Alternative Waste Treatment System Installation (RB-5)	100%	-	-
Pet Waste Management Education Program	Program	Program	Program
Pet Waste Station	75%	100%	-
<b>Existing BMPs and Detention Pond Retrofits</b>			
Infiltration Trench	75%	100%	-
Constructed Wetlands	75%	100%	-
Street Sweeping	Program	Program	Program
<b>Stormwater BMPs</b>			
Bioretention	25%	90%	100%
Rain Gardens	50%	90%	100%
Infiltration Trench	25%	90%	100%
Manufactured BMPs	50%	90%	100%
Constructed Wetland	25%	90%	100%
Detention Pond	25%	90%	100%
Permeable Paver	25%	75%	100%
Vegetated Swale	25%	90%	100%
Rain Barrel	100%	-	-
Riparian Buffer: Forest	100%	-	-
Riparian Buffer: Grass/Shrub	100%	-	-
Urban Tree Canopy/Land Use Conversion	25%	90%	100%
<b>Cropland BMPs</b>			
Continuous No-Till (SL-15)	100%	-	-
Small Grain Cover Crop (SL-8)	100%	-	-
<b>Livestock Exclusion Systems and Manure Management</b>			
Livestock Exclusion (CRSL-6)	100%	-	-
Livestock Exclusion (SL-6T/LE-1T)	100%	-	-
Livestock Exclusion with Reduced Setback (LE-2T)	100%	-	-
Manure Storage (WP-4)	100%	-	-
<b>Pasture BMPs</b>			
Reforestation of Erodible Pasture (FR-1)	100%	-	-
Pasture Management (EQIP 528, SL-10T, SL-9)	100%	-	-
Vegetative Cover on Critical Areas (SL-11)	100%	-	-
<b>Stream Restoration</b>			
Stream Restoration	50%	100%	-

**Table 12. Mason Creek Implementation Staging**

Best Management Practice	Unit	Stage I (Y1-Y6)*	Stage II (Y7-Y12)* Delisting Stage	Stage III (Y13-Y15)* TMDL Attainment Stage
<b>Residential BMPs</b>				
Septic System Pump-Out (RB-1)	Pump Out	129	-	-
Sewer Connection (RB-2)	System	141	422	563
Repaired Septic System (RB-3)	System	85	-	-
Septic System Installation/Replacement (RB-4)	System	133	-	-
Alternative Waste Treatment System Installation (RB-5)	System	11	-	-
Pet Waste Management and Education Program	Program	Program	Program	Program
Pet Waste Station	Unit	5	6	-
<b>Existing BMPs and Detention Pond Retrofits</b>				
Infiltration Trench	System	13	17	-
Constructed Wetlands	System	8	10	-
Street Sweeping (additional miles to be swept annually)**	Miles Swept	4,008	4,008	2,004
<b>Stormwater BMPs</b>				
Bioretention	Acre Treated	147.5	531.0	590.0
Rain Gardens	Acre Treated	59.0	106.2	118.0
Infiltration Trench	Acre Treated	29.3	105.3	117.0
Manufactured BMPs	Acre Treated	71.0	127.8	142.0
Constructed Wetland	Acre Treated	480.3	1,728.9	1,921.0
Detention Pond	Acre Treated	49.0	176.4	196.0
Permeable Paver	Acre Treated	1.3	3.8	5.0
Vegetated Swale	Acre Treated	37.5	135.0	150.0
Rain Barrel	System	86	-	-
Riparian Buffer: Forest	Acre Installed	2.0	-	-
Riparian Buffer: Grass/Shrub	Acre Installed	2.0	-	-
Urban Tree Canopy/Land Use Conversion	Acre Converted	4	14	16
<b>Cropland BMPs</b>				
Continuous No-Till (SL-15)	Acre Installed	9.0	-	-
Small Grain Cover Crop (SL-8)	Acre Installed	9.0	-	-
<b>Livestock Exclusion Systems and Manure Management</b>				
Livestock Exclusion (CRSL-6)	System	1	-	-
Livestock Exclusion (SL-6T/LE-1T)	System	7	-	-
Livestock Exclusion with Reduced Setback (LE-2T)	System	1	-	-
Manure Storage (WP-4)	System	2	-	-
<b>Pasture BMPs</b>				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	52.0	-	-
Pasture Management (EQIP 528, SL-10T)	Acre Installed	470.0	-	-
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	94.0	-	-
<b>Stream Restoration</b>				
Stream Restoration	Feet	5,132	10,264	-

\*Numbers represent cumulative total of BMPs implemented

\*\*Mileage shown corresponds to the total additional miles to be swept within the implementation plan stage (Annual Miles x Number of Years). This implementation plan is proposing to sweep 668 additional miles per year in Mason Creek.



<b>Table 13. Mud Lick Creek, Murray Run, and Ore Branch Implementation Staging</b>			
Best Management Practice	Stage I (Y1-Y8)	Stage II (Y9-Y16) Delisting Stage	Stage III (Y17-Y20) TMDL Attainment Stage
<b>Residential BMPs</b>			
Septic System Pump-Out (RB-1)	100%	-	-
Repaired Septic System (RB-3)	100%	-	-
Septic System Installation/Replacement (RB-4)	100%	-	-
Alternative Waste Treatment System Installation (RB-5)	100%	-	-
Pet Waste Management Education Program	Program	Program	Program
Pet Waste Station	75%	100%	-
<b>Existing BMPs and Detention Pond Retrofits</b>			
Infiltration Trench	75%	100%	-
Constructed Wetlands	75%	100%	-
Street Sweeping	Program	Program	Program
<b>Stormwater BMPs</b>			
Bioretention	25%	90%	100%
Rain Gardens	50%	90%	100%
Infiltration Trench	25%	90%	100%
Manufactured BMPs	50%	90%	100%
Constructed Wetland	25%	90%	100%
Detention Pond	25%	90%	100%
Permeable Paver	25%	75%	100%
Vegetated Swale	25%	90%	100%
Rain Barrel	50%	100%	-
Riparian Buffer: Forest	75%	100%	-
Riparian Buffer: Grass/Shrub	75%	100%	-
Urban Tree Canopy/Land Use Conversion	25%	90%	100%
<b>Cropland BMPs</b>			
Continuous No-Till (SL-15)	100%	-	-
<b>Livestock Exclusion Systems and Manure Management</b>			
Livestock Exclusion (SL-6T/LE-1T)	100%	-	-
<b>Pasture BMPs</b>			
Reforestation of Erodible Pasture (FR-1)	100%	-	-
Pasture Management (EQIP 528, SL-10T)	100%	-	-
Vegetative Cover on Critical Areas (SL-11)	100%	-	-
<b>Stream Restoration</b>			
Stream Restoration	100%	-	-

**Table 14. Mud Lick Creek, Murray Run, and Ore Branch Implementation Staging**

Best Management Practice	Unit	Stage I (Y1-Y8)*	Stage II (Y9-Y16)* Delisting Stage	Stage III (Y17-Y20)* TMDL Attainment Stage
<b>Residential BMPs</b>				
Septic System Pump-Out (RB-1)	Pump Out	23	-	-
Repaired Septic System (RB-3)	System	20	-	-
Septic System Installation/Replacement (RB-4)	System	6	-	-
Alternative Waste Treatment System Installation (RB-5)	System	1	-	-
Pet Waste Management Education Program	Program	Program	Program	Program
Pet Waste Station	Unit	11	14	-
<b>Existing BMPs and Detention Pond Retrofits</b>				
Infiltration Trench	System	19	25	-
Constructed Wetlands	System	60	80	-
Street Sweeping (additional miles to be swept annually)**	Miles Swept	9,928	9,928	4,964
<b>Stormwater BMPs</b>				
Bioretention	Acre Treated	375.0	1,350.0	1,500.0
Rain Gardens	Acre Treated	150.0	270.0	300.0
Infiltration Trench	Acre Treated	74.8	269.1	299.0
Manufactured BMPs	Acre Treated	181.0	325.8	362.0
Constructed Wetland	Acre Treated	1,118.0	4,024.8	4,472.0
Detention Pond	Acre Treated	49.0	176.4	196.0
Permeable Paver	Acre Treated	1.3	3.8	5.0
Vegetated Swale	Acre Treated	37.5	135.0	150.0
Rain Barrel	System	173	345	-
Riparian Buffer: Forest	Acre Installed	11.3	15.0	-
Riparian Buffer: Grass/Shrub	Acre Installed	11.3	15.0	-
Urban Tree Canopy/Land Use Conversion	Acre Converted	12.0	43.2	48.0
<b>Cropland BMPs</b>				
Continuous No-Till (SL-15)	Acre Installed	3.0	-	-
<b>Livestock Exclusion Systems and Manure Management</b>				
Livestock Exclusion (SL-6T/LE-1T)	System	1	-	-
<b>Pasture BMPs</b>				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	9.0	-	-
Pasture Management (EQIP 528, SL-10T, SL-9)	Acre Installed	10.0	-	-
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	9.0	-	-
<b>Stream Restoration</b>				
Stream Restoration	Feet	5,482	-	-

\*Numbers represent cumulative total of BMPs implemented

\*\*Mileage shown corresponds to the total additional miles to be swept within the implementation plan stage (Annual Miles x Number of Years). This implementation plan is proposing to sweep 1,241 additional miles per year in Mud Lick Creek, Murray Run, and Ore Branch.

<b>Table 15. Peters Creek Implementation Staging</b>			
Best Management Practice	Stage I (Y1-Y6)	Stage II (Y7-Y12) Delisting Stage	Stage III (Y13-Y15) TMDL Attainment Stage
<b>Residential BMPs</b>			
Septic System Pump-Out (RB-1)	100%	-	-
Sewer Connection (RB-2)	100%	-	-
Repaired Septic System (RB-3)	100%	-	-
Septic System Installation/Replacement (RB-4)	100%	-	-
Alternative Waste Treatment System Installation (RB-5)	100%	-	-
Pet Waste Management Education Program	Program	Program	Program
Pet Waste Station	75%	100%	-
<b>Existing BMPs and Detention Pond Retrofits</b>			
Infiltration Trench	75%	100%	-
Constructed Wetlands	75%	100%	-
Street Sweeping	Program	Program	Program
<b>Stormwater BMPs</b>			
Bioretention	25%	90%	100%
Rain Gardens	50%	90%	100%
Infiltration Trench	25%	90%	100%
Manufactured BMPs	50%	90%	100%
Constructed Wetland	25%	90%	100%
Detention Pond	25%	90%	100%
Permeable Paver	25%	75%	100%
Vegetated Swale	25%	90%	100%
Rain Barrel	75%	100%	-
Riparian Buffer: Forest	75%	100%	-
Riparian Buffer: Grass/Shrub	75%	100%	-
Urban Tree Canopy/Land Use Conversion	25%	90%	100%
<b>Livestock Exclusion Systems and Manure Management</b>			
Livestock Exclusion (SL-6T/LE-1T)	100%	-	-
<b>Pasture BMPs</b>			
Reforestation of Erodible Pasture (FR-1)	100%	-	-
Pasture Management (EQIP 528, SL-10T, SL-9)	100%	-	-
Vegetative Cover on Critical Areas (SL-11)	100%	-	-
<b>Stream Restoration</b>			
Stream Restoration	100%	-	-

**Table 16. Peters Creek Implementation Plan Staging**

Best Management Practice	Unit	Stage I (Y1-Y6)*	Stage II (Y7-Y12)* Delisting Stage	Stage III (Y13-Y15)* TMDL Attainment Stage
<b>Residential BMPs</b>				
Septic System Pump-Out (RB-1)	Pump Out	12	-	-
Sewer Connection (RB-2)	System	94	-	-
Repaired Septic System (RB-3)	System	8	-	-
Septic System Installation/Replacement (RB-4)	System	16	-	-
Alternative Waste Treatment System Installation (RB-5)	System	1	-	-
Pet Waste Management Education Program	Program	Program	Program	Program
Pet Waste Station	Unit	1	-	-
<b>Existing BMPs and Detention Pond Retrofits</b>				
Infiltration Trench	System	7	9	-
Constructed Wetlands	System	14	19	-
Street Sweeping (additional miles to be swept annually)**	Miles Swept	2,652	2,652	1,326
<b>Stormwater BMPs</b>				
Bioretention	Acre Treated	200.0	720.0	800.0
Rain Gardens	Acre Treated	80.0	144.0	160.0
Infiltration Trench	Acre Treated	39.8	143.1	159.0
Manufactured BMPs	Acre Treated	96.5	173.7	193.0
Constructed Wetland	Acre Treated	408.5	1,470.6	1,634.0
Detention Pond	Acre Treated	49.0	176.4	196.0
Permeable Paver	Acre Treated	1.3	3.8	5.0
Vegetated Swale	Acre Treated	37.5	135.0	150.0
Rain Barrel	System	135	180	-
Riparian Buffer: Forest	Acre Installed	8.3	11.0	-
Riparian Buffer: Grass/Shrub	Acre Installed	8.3	11.0	-
Urban Tree Canopy/Land Use Conversion	Acre Converted	5	18	20
<b>Livestock Exclusion Systems and Manure Management</b>				
Livestock Exclusion (SL-6T/LE-1T)	System	1	-	-
<b>Pasture BMPs</b>				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	18.0	-	-
Pasture Management (EQIP 528, SL-10T, SL-9)	Acre Installed	162.0	-	-
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	9.0	-	-
<b>Stream Restoration</b>				
Stream Restoration	Feet	2,245	-	-

\*Numbers represent cumulative total of BMPs implemented

\*\*Mileage shown corresponds to the total additional miles to be swept within the implementation plan stage (Annual Miles x Number of Years). This implementation plan is proposing to sweep 442 additional miles per year in Peters Creek.

<b>Table 17. Roanoke River 1 Implementation Staging</b>			
Best Management Practice	Stage I (Y1-Y8)	Stage II (Y9-Y16) Delisting Stage	Stage III (Y17-Y20) TMDL Attainment Stage
<b>Residential BMPs</b>			
Septic System Pump-Out (RB-1)	75%	100%	-
Sewer Connection (RB-2)	50%	75%	100%
Repaired Septic System (RB-3)	75%	100%	-
Septic System Installation/Replacement (RB-4)	75%	100%	-
Alternative Waste Treatment System Installation (RB-5)	75%	100%	-
Pet Waste Management Education Program	Program	Program	Program
Pet Waste Station	75%	100%	-
<b>Existing BMPs and Detention Pond Retrofits</b>			
Infiltration Trench	75%	100%	-
Constructed Wetlands	75%	100%	-
Street Sweeping	Program	Program	Program
<b>Stormwater BMPs</b>			
Bioretention	25%	90%	100%
Rain Gardens	50%	90%	100%
Infiltration Trench	25%	90%	100%
Manufactured BMPs	50%	90%	100%
Constructed Wetland	25%	90%	100%
Detention Pond	25%	90%	100%
Permeable Paver	25%	75%	100%
Vegetated Swale	25%	90%	100%
Rain Barrel	75%	100%	-
Riparian Buffer: Forest	50%	100%	-
Riparian Buffer: Grass/Shrub	50%	100%	-
Urban Tree Canopy/Land Use Conversion	25%	90%	100%
<b>Cropland BMPs</b>			
Continuous No-Till (SL-15)	100%	-	-
Small Grain Cover Crop (SL-8)	100%	-	-
Permanent vegetative cover on cropland (SL-1)	100%	-	-
Sod Waterway (WP-3)	100%	-	-
Cropland Buffer/Field Borders (CP-33 and WQ-1)	100%	-	-
<b>Livestock Exclusion Systems and Manure Management</b>			
Livestock Exclusion (CRSL-6)	100%	-	-
Livestock Exclusion (SL-6T/LE-1T)	100%	-	-
Livestock Exclusion with Reduced Setback (LE-2T)	100%	-	-
Small Acreage Grazing System (SL-6AT)	100%	-	-
Manure Storage (WP-4)	100%	-	-
<b>Pasture BMPs</b>			
Reforestation of Erodible Pasture (FR-1)	50%	100%	-
Pasture Management (EQIP 528, SL-10T, SL-9)	100%	-	-
Vegetative Cover on Critical Areas (SL-11)	50%	100%	-
<b>Stream Restoration</b>			
Stream Restoration	50%	100%	-

**Table 18. Roanoke River 1 Implementation Plan Staging**

Best Management Practice	Unit	Stage I (Y1-Y8)*	Stage II (Y9-Y16)* Delisting Stage	Stage III (Y17-Y20)* TMDL Attainment Stage
<b>Residential BMPs</b>				
Septic System Pump-Out (RB-1)	Pump Out	148	197	-
Sewer Connection (RB-2)	System	209	418	835
Repaired Septic System (RB-3)	System	101	134	-
Septic System Installation/Replacement (RB-4)	System	135	180	-
Alternative Waste Treatment System Installation (RB-5)	System	11	15	-
Pet Waste Management Education Program	Program	Program	Program	Program
Pet Waste Station	Unit	8	11	-
<b>Existing BMPs and Detention Pond Retrofits</b>				
Infiltration Trench	System	40	53	-
Constructed Wetlands	System	19	25	-
Street Sweeping (additional miles to be swept annually)**	Miles Swept	13,656	13,656	6,828
<b>Stormwater BMPs</b>				
Bioretention	Acre Treated	343.8	1,237.5	1,375.0
Rain Gardens	Acre Treated	137.5	247.5	275.0
Infiltration Trench	Acre Treated	68.5	246.6	274.0
Manufactured BMPs	Acre Treated	166.0	298.8	332.0
Constructed Wetland	Acre Treated	1,196.8	4,308.3	4,787.0
Detention Pond	Acre Treated	49.0	176.4	196.0
Permeable Paver	Acre Treated	1.3	3.8	5.0
Vegetated Swale	Acre Treated	37.5	135.0	150.0
Rain Barrel	System	278	370	-
Riparian Buffer: Forest	Acre Installed	15.0	30.0	-
Riparian Buffer: Grass/Shrub	Acre Installed	15.0	30.0	-
Urban Tree Canopy/Land Use Conversion	Acre Converted	17.5	63.0	70.0
<b>Cropland BMPs</b>				
Continuous No-Till (SL-15)	Acre Installed	25.0	-	-
Small Grain Cover Crop (SL-8)	Acre Installed	5.0	-	-
Permanent vegetative cover on cropland (SL-1)	Acre Installed	2.0	-	-
Sod Waterway (WP-3)	Acre Installed	4.0	-	-
Cropland Buffer/Field Borders (CP-33 and WQ-1)	Acre Installed	2.0	-	-
<b>Livestock Exclusion Systems and Manure Management</b>				
Livestock Exclusion (CRSL-6)	System	2	-	-
Livestock Exclusion (SL-6T/LE-1T)	System	14	-	-
Livestock Exclusion with Reduced Setback (LE-2T)	System	2	-	-
Small Acreage Grazing System (SL-6AT)	System	1	-	-
Manure Storage (WP-4)	System	4	-	-
<b>Pasture BMPs</b>				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	79.5	159.0	-
Pasture Management (EQIP 528, SL-10T, SI-9)	Acre Installed	1,430.0	-	-
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	143.0	286.0	-
<b>Stream Restoration</b>				
Stream Restoration	Feet	11,253	22,506	-

\*Numbers represent cumulative total of BMPs implemented

\*\*Mileage shown corresponds to the total additional miles to be swept within the implementation plan stage (Annual Miles x Number of Years). This implementation plan is proposing to sweep 1,707 additional miles per year in Roanoke River 1.

<b>Table 19. Roanoke River 2 Implementation Staging</b>			
Best Management Practice	Stage I (Y1-Y8)	Stage II (Y9-Y16) Delisting Stage	Stage III (Y17-Y20) TMDL Attainment Stage
<b>Residential BMPs</b>			
Septic System Pump-Out (RB-1)	100%	-	-
Sewer Connection (RB-2)	75%	100%	-
Repaired Septic System (RB-3)	100%	-	-
Septic System Installation/Replacement (RB-4)	100%	-	-
Alternative Waste Treatment System Installation (RB-5)	100%	-	-
Pet Waste Management Education Program	Program	Program	Program
Pet Waste Station	75%	100%	-
<b>Existing BMPs and Detention Pond Retrofits</b>			
Infiltration Trench	75%	100%	-
Constructed Wetlands	75%	100%	-
Street Sweeping	Program	Program	Program
<b>Stormwater BMPs</b>			
Bioretention	25%	90%	100%
Rain Gardens	50%	90%	100%
Infiltration Trench	25%	90%	100%
Manufactured BMPs	50%	90%	100%
Constructed Wetland	25%	90%	100%
Detention Pond	25%	90%	100%
Permeable Paver	25%	75%	100%
Vegetated Swale	25%	90%	100%
Rain Barrel	50%	100%	-
Riparian Buffer: Forest	75%	100%	-
Riparian Buffer: Grass/Shrub	75%	100%	-
Urban Tree Canopy/Land Use Conversion	25%	90%	100%
<b>Cropland BMPs</b>			
Continuous No-Till (SL-15)	100%	-	-
<b>Livestock Exclusion Systems and Manure Management</b>			
Livestock Exclusion (CRSL-6)	100%	-	-
Livestock Exclusion (SL-6T/LE-1T)	100%	-	-
Livestock Exclusion with Reduced Setback (LE-2T)	100%	-	-
Small Acreage Grazing System (SL-6AT)	100%	-	-
Manure Storage (WP-4)	100%	-	-
<b>Pasture BMPs</b>			
Reforestation of Erodible Pasture (FR-1)	50%	100%	-
Pasture Management (EQIP 528, SL-10T, SL-9)	100%	-	-
Vegetative Cover on Critical Areas (SL-11)	50%	100%	-
<b>Stream Restoration</b>			
Stream Restoration	100%	-	-

**Table 20. Roanoke River 2 Implementation Staging**

Best Management Practice	Unit	Stage I (Y1-Y8)*	Stage II (Y9-Y16)* Delisting Stage	Stage III (Y17-Y20)* TMDL Attainment Stage
<b>Residential BMPs</b>				
Septic System Pump-Out (RB-1)	Pump Out	153	-	-
Sewer Connection (RB-2)	System	29	39	-
Repaired Septic System (RB-3)	System	86	-	-
Septic System Installation/Replacement (RB-4)	System	86	-	-
Alternative Waste Treatment System Installation (RB-5)	System	8	-	-
Pet Waste Management Education Program	Program	Program	Program	Program
Pet Waste Station	Unit	17	22	-
<b>Existing BMPs and Detention Pond Retrofits</b>				
Infiltration Trench	System	22	29	-
Constructed Wetlands	System	16	21	-
Street Sweeping (additional miles to be swept annually)**	Miles Swept	8,592	8,592	4,296
<b>Stormwater BMPs</b>				
Bioretention	Acre Treated	312.5	1,125.0	1,250.0
Rain Gardens	Acre Treated	125.0	225.0	250.0
Infiltration Trench	Acre Treated	62.3	224.1	249.0
Manufactured BMPs	Acre Treated	151.0	271.8	302.0
Constructed Wetland	Acre Treated	1,433.3	5,159.7	5,733.0
Detention Pond	Acre Treated	49.0	176.4	196.0
Permeable Paver	Acre Treated	1.3	3.8	5.0
Vegetated Swale	Acre Treated	37.5	135.0	150.0
Rain Barrel	System	215	430	430
Riparian Buffer: Forest	Acre Installed	21.0	28.0	28.0
Riparian Buffer: Grass/Shrub	Acre Installed	21.0	28.0	28.0
Urban Tree Canopy/Land Use Conversion	Acre Converted	12.5	45.0	50.0
<b>Cropland BMPs</b>				
Continuous No-Till (SL-15)	Acre Installed	1.0	-	-
<b>Livestock Exclusion Systems and Manure Management</b>				
Livestock Exclusion (CRSL-6)	System	1	-	-
Livestock Exclusion (SL-6T/LE-1T)	System	8	-	-
Livestock Exclusion with Reduced Setback (LE-2T)	System	1	-	-
Small Acreage Grazing System (SL-6AT)	System	1	-	-
Manure Storage (WP-4)	System	4	-	-
<b>Pasture BMPs</b>				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	73.0	146.0	-
Pasture Management (EQIP 528, SL-10T, SL-9)	Acre Installed	1,316.0	-	-
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	131.5	263.0	-
<b>Stream Restoration</b>				
Stream Restoration	Feet	2,674	-	-

\*Numbers represent cumulative total of BMPs implemented

\*\*Mileage shown corresponds to the total additional miles to be swept within the implementation plan stage (Annual Miles x Number of Years). This implementation plan is proposing to sweep 1,074 additional miles per year in Roanoke River 2.



<b>Table 21. Tinker Creek Implementation Plan</b>			
Best Management Practice	Stage I (Y1-Y8)	Stage II (Y9-Y16) Delisting Stage	Stage III (Y17-Y20) TMDL Attainment Stage
<b>Residential BMPs</b>			
Septic System Pump-Out (RB-1)	75%	100%	-
Sewer Connection (RB-2)	75%	100%	-
Repaired Septic System (RB-3)	75%	100%	-
Septic System Installation/Replacement (RB-4)	75%	100%	-
Alternative Waste Treatment System Installation (RB-5)	75%	100%	-
Pet Waste Management Education Program	Program	Program	Program
Pet Waste Station	75%	100%	-
<b>Existing BMPs and Detention Pond Retrofits</b>			
Infiltration Trench	75%	100%	-
Constructed Wetlands	75%	100%	-
Street Sweeping	Program	Program	Program
<b>Stormwater BMPs</b>			
Bioretention	25%	90%	100%
Rain Gardens	50%	90%	100%
Infiltration Trench	25%	90%	100%
Manufactured BMPs	50%	90%	100%
Constructed Wetland	25%	90%	100%
Detention Pond	25%	90%	100%
Permeable Paver	25%	75%	100%
Vegetated Swale	25%	90%	100%
Rain Barrel	50%	100%	-
Riparian Buffer: Forest	75%	100%	-
Riparian Buffer: Grass/Shrub	75%	100%	-
Urban Tree Canopy/Land Use Conversion	25%	90%	100%
<b>Livestock Exclusion Systems and Manure Management</b>			
Livestock Exclusion (CRSL-6)	100%	-	-
Livestock Exclusion (SL-6T/LE-1T)	75%	100%	-
Livestock Exclusion with Reduced Setback (LE-2T)	100%	-	-
Small Acreage Grazing System (SL-6AT)	100%	-	-
Stream Protection Fencing (WP-2T)	100%	-	-
Manure Storage (WP-4)	50%	100%	-
<b>Pasture BMPs</b>			
Reforestation of Erodible Pasture (FR-1)	50%	100%	-
Pasture Management (EQIP 528, SL-10T, SL-9)	50%	100%	-
Vegetative Cover on Critical Areas (SL-11)	50%	100%	-
<b>Stream Restoration</b>			
Stream Restoration	50%	100%	-

**Table 22. Tinker Creek Implementation Staging**

Best Management Practice	Unit	Stage I (Y1-Y8)*	Stage II (Y9-Y16)* Delisting Stage	Stage III (Y17-Y20)* TMDL Attainment Stage
<b>Residential BMPs</b>				
Septic System Pump-Out (RB-1)	Pump Out	516	688	-
Sewer Connection (RB-2)	System	183	244	-
Repaired Septic System (RB-3)	System	344	459	-
Septic System Installation/Replacement (RB-4)	System	419	558	-
Alternative Waste Treatment System Installation (RB-5)	System	37	49	-
Pet Waste Management Education Program	Program	Program	Program	Program
Pet Waste Station	Unit	5	7	-
<b>Existing BMPs and Detention Pond Retrofits</b>				
Infiltration Trench	System	24	32	-
Constructed Wetlands	System	20	27	-
Street Sweeping (additional miles to be swept annually)**	Miles Swept	3,456	3,456	1,728
<b>Stormwater BMPs</b>				
Bioretention	Acre Treated	310.0	1,116.0	1,240.0
Rain Gardens	Acre Treated	124.0	223.2	248.0
Infiltration Trench	Acre Treated	61.8	222.3	247.0
Manufactured BMPs	Acre Treated	149.5	269.1	299.0
Constructed Wetland	Acre Treated	1,376.0	4,953.6	5,504.0
Detention Pond	Acre Treated	49.0	176.4	196.0
Permeable Paver	Acre Treated	1.3	3.8	5.0
Vegetated Swale	Acre Treated	37.5	135.0	150.0
Rain Barrel	System	179	358	-
Riparian Buffer: Forest	Acre Installed	19.5	26.0	-
Riparian Buffer: Grass/Shrub	Acre Installed	19.5	26.0	-
Urban Tree Canopy/Land Use Conversion	Acre Converted	6.0	21.6	24.0
<b>Livestock Exclusion Systems and Manure Management</b>				
Livestock Exclusion (CRSL-6)	System	4	-	-
Livestock Exclusion (SL-6T/LE-1T)	System	41	55	-
Livestock Exclusion with Reduced Setback (LE-2T)	System	6	-	-
Small Acreage Grazing System (SL-6AT)	System	3	-	-
Stream Protection/Fencing (WP-2T)	System	2	-	-
Manure Storage (WP-4)	System	15	30	-
<b>Pasture BMPs</b>				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	361.0	722.0	-
Pasture Management (EQIP 528, SL-10T, SL-9)	Acre Installed	3,248.5	6,497.0	-
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	649.5	1299.0	-
<b>Stream Restoration</b>				
Stream Restoration	Feet	7,499	14,999	-

\*Numbers represent cumulative total of BMPs implemented

\*\*Mileage shown corresponds to the total additional miles to be swept within the implementation plan stage (Annual Miles x Number of Years). This implementation plan is proposing to sweep 432 additional miles per year in Tinker Creek.